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ABSTRACT

This research employs an ethnographic approach in the examination of the effects that computers in schools have on student learning in the United States. It is argued that emphasis on technology, science, and mathematics is not enough to meet educational needs in America. The enthusiasm fostered by technological innovation often overshadows certain crucial questions with regard to how computers are used, the role that technology plays in solving problems, the role that computers play in educating a future workforce, and the long-term effects of technology in schools. Data is comprised of field notes and interviews that were recorded and transcribed. Findings indicate that a high volume of computer equipment does not guarantee competent students and that computers work best as tools of instruction. (Contains 18 references.) (DDR)

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Computers in Schools: are they really making a difference?
A Brazilian glance in American Schools

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ABSTRACT

In this article I present the challenges American Schools and teachers are facing to incorporate informatics into their curriculum. Using qualitative methods I show a puzzling picture of how computers are viewed and used by American teachers, which pushes me to say: No, computers are not yet making a difference in the school setting.

1. Introduction

The world has changed. Work is changing. The way society produces its means to survive is changing. The US and its major partners are in competition for high skills, high wage jobs. The role of schools in that competition has been (not that it should be) to improve the techniques of the educational system and teaching mastery of the tools of the Information Age. Educational reform and its relationship to America's place in the world have been high on the public's agenda.

About a decade ago the National Commission on Excellence in Education issued its report to the Secretary of Education entitled *A Nation at Risk*. The report began with the statement: "Our nation is at risk. Our once unchallenged prominence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world ...[mostly because] the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a Nation and a people" (A Nation at Risk, 1993, p.5).

The response across the Nation to the calls for educational reform came "throughout the nation, public and private actions by individuals and groups at local, state, and national levels [were] meeting the challenge to improve education" (op.cit., p.1). Literally hundreds of specific recommendations have been put forward by researchers, public

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leaders, opinion moulders, and school officials. They all flow to a common issue. Since 1983 the "most frequent initiative to improve teaching [has been] providing additional training or education for teachers in high demand areas, such as mathematics, science, and computer science" (op.cit., p. 6). Moreover in the heart of the discussion is the one same belief: "Technology today is everywhere, demanding high levels of competence in selecting and using appropriate technology, visualising operations, using technology to monitor tasks, and maintaining and trouble shooting complex equipment." (SCANS, 1991, p.13).

Defining the Scenario: Technology and Schools for 21st Century

The VISION: TEST (Technologically Enriched Schools of Tomorrow) report tells us on page 2, "As we look at the several major sectors of our economy, the educational system is the only one in which productivity has not improved over the past several decades," and subtlety inducing us to their conclusion, "it is the only one which has not fully integrated technology into its system". And it goes on presenting us the solution in the next paragraph "To put the issue of educational technology into perspective, we observe that, in the auto rental business, the technology investment per counter worker is $10,000, while in education, if the teacher is considered the worker, this investment is $1,000. **If the student is considered the worker (as many are proposing), the technology investment is a minuscule $100 per worker!** (emphasis on the report). Is it money investment really the solution?

We have here a clear example of the Welfare State where the "actions in the educational area have a tendency to privilege aspects which constitute indicators of growing modernization, besides the number of students versus population, such as equipment, laboratories, audio-visual media (...) reducing the educational planning to purely formal actions" (Weber, p. 13).

Nonetheless, Pelgrum & Plomb (1991) report that the USA leads the world in raw numbers of school computers, as well as in computer density measured by the ratio of students to computers. The Congressional Office of Technology Assessment estimates that every year in the past decade, schools have added between 300,000 and 400,000 computers to this inventories. Total public K-12 instructional technology (including computers, video, television, telecommunications networks, etc.) expenditures for 1993 were estimated at $ 2. 13 billion (AERA Conference, 1995). The numbers are impressive. Yet they seem inadequate to fill American educational gaps.

In the *Educating Americans for the 21st Century* Report the "solutions to teaching" presented are that as "both elementary and secondary teachers should be computer literate. Teacher training should incorporate the use of calculators and computers in mathematics and science instruction" (vol.1, p. IX). Hence, computers in Education have become "a must" in the National Agenda. According to them, computers have become "The answer" to solve "all" the schools' problems, a way to measure educational administrators' efforts towards effectiveness, "the way" politicians believe

will make the US recover its lead in the world market, certainly a means to the American hardware and software industries to maintain themselves selling their products.

In spite of not having a National (Federal) law to support the use of Technology in American Schools, computers have become a way of life in American schools. Ninety-nine percent of the elementary and secondary schools in the US have installed computers, and over 90 percent of the students use them during the school year, says Anderson in the IEA's report: "Computers are revolutionizing many areas of our lives; they may well do the same for education. They and other new technologies offer the potential to work patiently with every student, regardless of level or sophistication" (Anderson, e-mail).

In *Educating Americans for the 21st* Century, the authors offer a means to relieve teachers of much of the drudgery of routine exercise and record keeping. Furthermore, they assure computers offer a "wealth of interactive learning resources, including access toward processing, data bases, graphic capabilities and a host of related means to expand students' learning potential" (vol.1, pp.-XII). They keep going on saying that "if this promise is fulfilled, computers could simultaneously provide a new standard of achievement and lower the cost of education" (op. cit. p. XII). It means that if we believe computers do everything they're saying, we may just wait, and computers themselves will do the job: that is the reification of the computer.

Despite their best efforts though, most schools have not changed much in nearly a decade. Business and education leaders report computers as "significant in motivating and maintaining 10 years of important activity, but unsatisfactory in terms of documented results within the public school system" (Lund & Wild, 1993, p.24).

Emphasis on technology, mathematics and science is certainly not enough to meet the needs in American education. Therefore, in the ongoing debate and definition over educational policies, the enthusiasm fostered by technological innovation and its application in the educational systems often overshadows these crucial questions:

- How are these computers being used at schools?
- Can a sophisticated and expensive technology solve the problems of American schools?
- Can computer and all paraphernalia that comes along with it answer the demand "to produce the best educated workforce equal to any in the world, the citizens for the 21st century"?
- Can education actually be measured by "gigabits per second", or "miles of fiber optic cable"?
- What is in fact missing in American education?
- Where is this emphasis on technology leading the schools?

Lund and Wild, in the study *10 years after a Nation at Risk* offer no congratulations on the progress of educational reform since the publication of the first report. They are

moderate in their praise of business involvement. While affirming the good intentions and the effort in workplace programs, they are deeply disturbed by the lack of broad-based measurable results. (P.8)
The report says that "**a decade of business involvement in public schools**:

- has produced a durable commitment to local communities and to the national interest
- reflects persistence in developing new programs and new relationships
- has shown greatest success in building broad-based coalitions with clear goals

has effectively attracted and maintained public attention to education concerns
But

- **has not yet produced documented wide-scale improvement** " (emphasis are mine).

Therefore, it cannot be only a matter of quantity. Numbers: the typical high school had one computer for every 10 students; the typical elementary and typical middle school had one computer for every 15 students. (Anderson, 1993). Let's not forget all the technological equipment that comes along with computer multimedia peripherals (e.g., CD-ROMs, videodisks, etc.), antennas, modems to assure access to the electronic network. It has to have a "pedagogical approach that takes in account the learning process as well as the reflection about the social relation between people and between people and machine" (Jurema & CostaLima, 1993)

In summary, as Anderson (op.cit, 1993) says, between 1989 and 1992 American schools acquired nearly 50% more computers bringing to their inventory to a total of 3.5 million. Quantity and numbers are exciting. The applications of computers are exciting. It also excites industry: not only hardware, but software industry as well. What kind of materials are they producing? Whose needs are they providing? That is certainly the way schools are getting a ride to arrive at the 21st century.

2. Exploring by Questioning

The dissatisfaction with the American schools performance is a fact. The massive infusion of technology into American Schools is another fact. Both have generated a good deal of projects, research and reports on reforming, restructuring as we have seen lately. Most of the reports (see References) present technology (in its computer variation) as the reified instrument to give American schools a ride to the 21st century.

Recognizing that technology (as any other social product) is not neutral, I would like to observe what kind of changes (if any) the use of technology (computers, specifically) is bringing to schools I intended to find out about the impacts of this use in the school's culture: why sophisticated 21st century machines are sometimes being used as steam machines of 19th century or not used at all. What is, for schools, to be at the 21st century and what is missing to be there? Some contextual questions led my research:

- What is the role of computers in preparing the students to become "citizens of the 21st century"?
- What is the place of technology (mainly computers and computer related ones) in the teaching and learning process.
- What does *really* change at school when the students work with computers?
- Why and how are they using computers in their schools?
- Who really gains by the massive inclusion of computer technology in education? (School alone, nor computers at school, will solve the social problems).

These questions guided my research focus: how are computers viewed by American teachers, how have they been used in American schools. Coming in the next sections some explanations on how I did, and the answers I got.

Methodology

I went to the school setting in order to observe, take fieldnotes, write them up, reflect upon them, go back to school and interview teachers, gather more information, search documents and read, reflecting while writing up more. This way I was being mindful of what ethnographers usually tells us to mind - to the discovery of how things are and how they got that way in a permanent motion—*In ethnography (...) you learn something, then you try to make sense out of it, then you go back and see if the interpretation makes sense in light of new experience, then you refine your interpretation, and so on. The process is dialectic, not linear* (Agar, 1980, p.9. In: Wolcott, 1994, p.11).

I believe *in the multiple realities of social construction*. Therefore, my approach to the questions I mentioned above and the data I gathered could not be a linear approach of cause-effect. Instead I tried to have a much more holistic understanding of how things change over time. So, instead of "describe, predict, and control," my goal as an interpretivist researcher is better stated as "describe, interpret, and understand." (Ferguson, P., Ferguson, D. & Taylor, S., p. 6). That is why I based this exploratory study in interviews, interviewing administrators and teachers, as well as on fieldnotes taken from observations I made. I went to the computer Labs of the schools during students' free time. And, then, systematically, during classes, observing teacher and students interaction in the classroom, while using computers.

After observing several schools in urban in rural areas in the state of Oregon, I chose to work in a well-known (urban) middle school, very proud of its two computers' laboratory recently renewed. One of them with thirty computers, two printers (one of them laser). The quantity of the equipment I saw as well as all the newness of the computers. The abundance of materials, software, etc., together with all the cleaned and neat halls and the classrooms, all these gave me the assurance of a school for middle-class students. The schedule on the wall showing a full use of computers lab, spacious and clear place, clean and neat tables and chairs, nothing sloppy or falling apart or even dirty reiterated this assurance.

I collected the data for a period of over three months, using primarily the in-depth, semi-structured interview kind. I personally conducted the three interviews. I agreed in advance first with the vice-principal, then with the other three teachers that we would discuss in general about the use of technology at school, particularly computers, and I had a very general list of questions about the accorded theme, some sort of "interview guide" to ensure all interviewees would go through the same set of questions, as shown below:

1. What do you mean when you use the word technology in the school setting?
Prompts: *What does technology mean to you in the school setting?*
What do use the term computer to mean?
2. How is your school using technology using computers?
Prompts: *Tell me about the computer use by students and teachers in you school.*
Asking details such as
What types of programs are you using?
What are students doing with computers?
What sort of progress have they made?
What will the students be able to do?
3. Why did your school is using technology computers with students?
Prompts: *Why did your school start using computers in the curriculum? If they don't know ask them why they think.*
Why do you think the schools are using them now?
What are your goals and objectives in teaching with computers?
4. How was the decision made to use computers? How is it continuing to be made?
Prompts: *How did you develop a "vision" for what computers could do for students?*
How are decisions made in the school?
Would you do it differently now?
What directions are you headed in now?
5. A vision for the future
Prompts: *How could computers improve learning for the students?*
What do you think your school will look like in five years?
How do you think students will be learning?

Two of the interviews lasted for about an hour, and took place at the school setting. The third one lasted for about an hour and a half, was done together with two of the teachers, at one of their home. All interviews were tape-recorded and transcribed.

As I said, I interviewed the vice-principal and three more teachers who made use of computers in their classroom. These teachers could be considered as "critical cases", as defined by M. Patton (1980), i.e., individuals who represented special knowledge or unique or interesting perspectives. The vice-principal suggested me to interview a math teacher, a science teacher and the technology teacher. In this case, by their special knowledge and intensive use of computers with their students, as well as at their own academic life: preparing working sheets, grading sheets, and so on.

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Analysis usually begins while data are still being collected: the experience of others has taught me (Ferguson & Ferguson's classroom memories), and I have realized in the field. While transcribing the interviews, I also had time to reflect upon the data. At first, after having the transcriptions in hand I have gone through reading them exhaustively, finding descriptive labels, and then some recurrent properties (categories), and finally I started *giving them voice*. At the heart of this process of analysis "is the interpretativist's conviction that facts are always silent. They never speak for themselves; we always give them voice in the language of our assumptions. Theories emerge from our data only as we ask them to, grounded in the transcripts but nurtured into patterns of insight and explanation that we admittedly help to create" (Ferguson & Ferguson, p. 6). And the results showed a puzzling picture, as I show in the next section.

3. A puzzling picture

So far in this exploratory study the moving picture I can visualize from what I have seen and talked with teachers is that a large investment has been made by schools in order to acquire and update their equipment, get on the superhighway at the Information Age, etc. Great claims are made by those who favor this particular form of technology. Computerization is seen as capable of solving, if not all at least many of the educational problems, as the reports on public policies preach.

The teachers' speeches combine with what is announced in the public reports and policies. Nevertheless there is a clear gap between the high level of expectations, which is put in using computers in schools and the actual use of computers. There is a clear dissonance between the teachers' expectations, their speech, the investment made, and the actual feedback received and repercussions of this tool in the school settings, and much less in the classrooms. In fact, the promised changes in the learning and teaching process are seemingly not happening.

The data I analysed showed me that the teachers' view of technology & computer is usually limited, narrow and focus on technology for technology's sake. For example, when they were asked about what computers meant in the school setting, one teacher said:

"Right now means a personal computer ... I'm not sure" ... "a CPU, some kind of input device, some kind of output device, a monitor, connected to each other through a network".

When I insisted, trying to get a broader view by linking computers to the learning process, the same teacher said:

"That's what I've just said... I'm not really sure of what you're asking (...) I don't know what else to say. You know what a computer is. This is a computer" (pointing to me a machine)

Matching with the policy statements, teacher's speeches sounded excited about using computers in their classrooms. However, giving the teachers' data a voice, the results showed a superficial view and use of computers. It sounded as merely excitement of using a 'modern' tool, which is motivating, fun, challenging, different.

It's a wonderful tool - I cant' do my work without one anymore - in fact I can't write

I think [students] are excited about it

Computers can be used for a number of different things - computers tend to be for a lot of kids very motivating - they're anxious to use them - it makes the completion of a project a little more fun- a little challenging - a little different - maybe that won't last forever but at least at this point in time using a computer is - it's much easier to write a paper on a computer than it is to sit and laboriously handwritten it - the access thing to other information is quick and fun - organizing information is quick and it is fun.

The emphasis in their speech is on equipment.

"We just got a video camera that ties in with a process where you can tie a camcorder in with the Mac and you can do a HyperCard stack and use that to take pictures"

"Our goal is that there be enough computers in every classroom that kids have access to them and can use them - ideally classrooms will have large monitors so that somebody can sit down at the computer and demonstrate to the whole class on something that is as large as the large TV screen - we have some of those but not enough - we share them - I don't know that you need enough for everybody but that everybody feels that it is useful and their classroom would have access to them."

"We just got a video cameral that ties in with a process where you can tie a camcorder in with the Mac and you can do a HyperCard stack and use that to take pictures"

"Within the next two years we'll have a nice Internet type thing in the building so that there is enough power in it to be able to support that kind of a system"

"We will get a satellite dish and hopefully we can pick up off a satellite international broadcasts and some people will start using that slowly"

The idea that goes through the National Reports, mentioned in the introduction of this article, can be also found in the teachers speech, when they see computers as the solution, the answer to some of the social problems such as unemployment. It is the naïve and reified view of technology reforming schools and society . . .

"I think it helps kids do their work - I think it helps them process things - I think in future many jobs will be dependent on whether a person is computer literate or not - so part of our goal is to have all of our kids to be computer literate to various degrees."

Sometimes, however, they seemed somehow realistic, keeping a foot in reality, as the following statements show:

"I don't put quite as much - computers are valuable but they are a tool and that's all they are and they don't - they're only as good as the information you've got in them - you can set it up so it is a learning tool."

But, in fact, they based their opinions upon cliches whenever the teaching & learning situation is mentioned.

"computer is a learning tool"
or,
"they [computers] can help kids and teachers being more productive ...and to learn better the things they learn, to communicate with each other
or else,
"classrooms being more student driven in terms of goals and outcomes - kids more involved with setting their own goals - monitoring themselves."

Nevertheless, the dichotomy between speech and action is shown when the actual uses of computers are revealed by the teachers' own voices:

"kids are going down with their free time to the computer lab and their turning in a project that looks very nice and its organized - they've done a spell check - some of them have grammar check programs"

"our students do the newspaper on the Mac - we do schedules on spreadsheets - kids practice using budgets using spreadsheets. . . How else is it used? *In as many ways as people can think up to use them*

Teachers seem very comfortable when using computes for administrative purposes doing **administrative uses**: working sheets, evaluations, communicating with each other to set up meetings, etc.

"You know the other thing that has been interesting is that in years past we had quite a few clerical people in the building instead of teachers - you know they'd be down at IMC helping to writing out worksheets for teachers or making copies of things - what's happened in the last few years is that we [teachers] can much more quickly develop their own material that look very professional and wonderful and clear.

In reality, teachers' speech shows they are doing a superficial educative use of computers. They seem to use them mechanically, not **thinking computers** & related technology in the learning situation. It happens as we use a car. We know how to put it in movement and drive it. But we don't know how it really functions.

"that teaches them how to use the basic functions of the keyboard and the computers, the keys and how to keep your hands on the keyboard and to type without looking"

"I don't think we use them probably to the degree we should use them—of course they're used as word processors in language arts classes - kids come down and write papers and edit them and correct them and print the papers and turn them in—we have groups of kids in some classes who are developing projects using HyperCard stack"

"What we hope is that every student in the building gets a basic knowledge about how to type on a computer, knows how to turn a computer on, know how to deal with a typical program - how to load it where the memory is on the machine - where the memory is on the disk - how to use the network in the building - we also have a network in the building - you can send messages to anybody."

If there is a speechless technology teacher . . .

"The questions you are asking are very difficult (... long silence). *And you are asking the interviewee* (in this case he, himself) *to think very deeply about complicated things* (... silence). *I think it is hard* (...) *there's not a lot of motivation for me to reanalyse my inner thoughts . . .."*

There is hope in the English teacher speech.

"The goal is not simply to use - you want kids to understand computers and be able at least on a minimal level to know how to use them but the computer activity should arise of the instructional setting and the instructional need - in other words - just simply because I have a class I'm not going out looking for some to use the computer - what I'll do is look at one of the goals I want the kids to get out of the class - one of the things I might look at is how could a computer help a student or facilitate that - if you had a social studies class and we had questions about Romania - maybe through the international network we might help people to contact people in Romania we might search the library of congress for information or we might whatever was appropriate too reach the educational goals that we have for that class."

She makes me believe the teachers will find their way. For this moment, though, it is still a puzzling picture, which remains.

4. Closing the Gap

All this high-tech hyperbole hides that computer literacy involves not only the use of computers to accomplish a great spectrum of tasks, but also a general understanding of the capabilities and limitations of computers and their significance for the structure of

the society. It seems to me that what matters is the quantity of the equipment and its technical possibilities. These worries has put aside and substituted the true reason for schooling: the pedagogy. As I said elsewhere (Jurema et al., 1995), it is fundamental to build a pedagogy of the Informatics. That is, a set of materials that expresses didactically the basic concepts of the area, enabling to facilitate the processes of work, of the teaching and learning situation, of communication or even of the "computing literacy," in this Information society

Besides, I would go even further, by saying that it is not simply a matter of absence or careless pedagogical procedures, but, more importantly, stems from philosophical principles that underlie modern technology that should be embedded in the pedagogy. And they are not being reflected upon, either by teachers, or administrators, or much less by. Mere technological changes designed by the use of computers at schools may exacerbate instead of ameliorate some of the gaps we see in the classroom.

Another point that deserves our attention is that not a substantial number of teachers use computers and other technologies regularly for instruction. In the process of acquiring hardware and software for students to use, **teachers have often been overlooked**. Therefore, in spite of the great number of equipment at schools they may sometimes be underused, in some cases or not used at all. Although many teachers rationally understand the value of students learning about computers (not yet exactly *with* computers) and other technologies, some are scared or even unaware of the resources technology can offer them as professionals.

Anyhow, the pattern of using these computers has shown little change. It works only partially, "using a modern tool wearing an old guise" (Jurema & CostaLima, 1993). Getting to such conclusions makes urgent to re-think in order to re-invent how schools will address the forthcoming computer-based technology. It must not be only to move from teacher knowledge authority to computer-based knowledge authority. A new sight has to be embedded in a different understanding of educational use of technology. A new view must encourage students not only to learn about computers, or learn through computers, but learn with computers: "The most promising use of computers in learning environments, both formal and informal, is the use of the computer as a tool of instruction and an environment within which learning can occur" (Educating Americans vol.2, p.97). A view of computers, which does not reify computers, but works with the advantages, they might bring to the school setting.

If one recognizes, as I do, that the most important educational relationships are social, we shall therefore shift the focus of our attention "from visual intensity and electronic instantaneity to a constructive interaction between users and producers" (Bruffe, 1993, p. 102). As Anderson points out in his report " a high volume of computer equipment in the schools does not guarantee the students will acquire competencies. Students who have less machinery but a more effective curriculum may do better" (op.cit., p.105). Consequently, the technology and workplace should not be the focus of the policy in themselves. The focus should be on people; on their interaction and on how they could work cooperatively. In this particular case, the focus should be on teachers. The

emphasis should shift from equipment to teachers' *capacitation*, in a way that, technology would be used in schools for education's sake, and not for technology's sake.

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